Dr. Subin K Jose Christ College

INTRODUCTION

Pollution may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or manmade. The agents that pollute are called pollutants.

Pollutants

Pollutants are by-products of man's action. The important pollutants are summarised below:

- **Deposited matter**—Soot, smoke, tar or dust and domestic wastes.
- **Gases**—CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals**—Lead, zinc, iron and chromium.
- **Industrial pollutants**—Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants**—Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants**—Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants**—Radioactive substances and radioactive fall-outs of the nuclear test.

Classification of Pollutants

On the basis of natural disposal, pollutants are of two types:

(i) **Non-biodegradable pollutants**

These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminium cans, mercuric salts and even DDT. These continue to accumulate in the environment.

(ii) **Biodegradable pollutants**

These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

On the basis of the form in which they persist after their release into the environment, pollutants can be categorized under two types:

(*i*) **Primary pollutants:** These include those substances, which are emitted directly from some identifiable sources. This include-

(*a*) *Sulphur compounds:* SO2, SO3, H2S produced by the oxidation of fuel.

(*b*) *Carbon compounds:* Oxides of carbon (CO+CO2) and hydrocarbons.

(*c*) *Nitrogen compounds:* NO2 and NH3.
(*d*) *Halogen compounds:* Hydrogen fluoride (HF) and hydrochloric acid (HCl).
(*e*) *Particles of different size and substances:* These are found suspended in air. The fine particles below the diameter of 100u are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.

(*ii*) **Secondary pollutants.** The secondary pollutants are produced by the combination of primary emitted pollutants. in the atmosphere. In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxyacetyle nitrate (PAN) and ozone (O3), Both of them are toxic components of smog and cause smarting eyes and lung damage.

(*iii*) **Smog.** The fog deposited with smoke and chemical fumes forms a dark and thick covering, the smog. Smog is very common in almost all the industrial areas as the smog is trapped for many days by the stagnant air. It is harmful both for animals and plants.

I. AIR POLLUTION

The World Health Organisation (WHO) defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

SOURCES OF AIR POLLUTION

Various sources of air pollution are fossil fuels, industries, agricultural activities, wars, natural causes arid emissions from vehicles.

(i) Burning Fossil Fuels

Burning of wood, charcoal and other fossil fuels causes air pollution by the release of carbon dioxide (CO2), carbon sulphur dioxide etc. Petroleum consists mainly of hydrocarbons, sulphur and nitrogen.

(ii) Emissions from Automobiles

Vehicles are mainly responsible for more than 80% of total air pollution. The major pollutants released from automobiles, locomotives, aircraft etc., include CO, unburnt hydrocarbons and nitrogen oxide.

(iii) Industries

Paper and pulp factories, petroleum refineries, fertilizer plants, and steel industries, thermal power plants are the main sources of air pollution. They add various harmful gases like CO, SO3, NO, Hydrocarbons etc., to the atmosphere. Textile factories release cotton dust into the air. Cities experiencing this type of pollution are Kanpur, Surat and Ahmedabad.
The pesticide and insecticide industries are posing serious threat to the environment. Food

processing industries and tanneries emit offensive odours. Release of poisonous gases from accidents also pose serious threats. e.g. Bhopal Gas Tragedy in which methyl isocyanate (MIC) gas leakage killed several people. In Tokyo, about 34 tonnes of carbon particles mixed with other suspended particles settle per square kilometre every day.

(iv) Agricultural Activities

Spraying of insecticides and weedicides also cause air pollution. These, when inhaled create severe problems to both animals and man.

(v) Wars

Various forms of explosives used in war pollute the air by releasing poisonous gases. This greatly disturbs the ecology of the area. Nuclear explosions pollute air by radioactive rays. The effects of nuclear explosions on Hiroshima and Nagasaki are well-known examples.

(vi) Natural Causes

Gas emissions from active volcanoes, marsh gas, spores of fungi and pollens are the natural causes of air pollution.

COMMON AIR POLLUTANTS

Air pollutants are of two main types- gaseous and particulate. Oxides of carbon. Nitrogen and sulphur are gaseous pollutants. Particulate pollutants may be solid or liquid particles, larger particles settle down quickly viz., sand and water droplets whereas small dust particles remain suspended in air for a long time. These are added into the atmosphere by the processes of blasting, drilling, crushing, grinding and mixing.

(i) Carbon Dioxide

CO_2 content of air has increased by 20% during the last century. CO_2 causes nausea and headache. It's increase in the air may cause greenhouse effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding of coastal regions.

(ii) Carbon Monoxide

It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled. it combines with haemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.

(iii) Oxides of Nitrogen

These include NO and NO_2, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.

(iv) Oxides of Sulphur

SO2 and SO3 are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO2 causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO2 and SO3 react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

(v) Photochemical Oxidants

Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with unburnt hydrocarbons to form Peroxyacetyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.

(vi) Hydrocarbons

These are unburnt discharges from incomplete combustion of fuel in automobiles. These form PAN with nitrogen oxides, which is highly toxic.

(vii) Particulate Matter

Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.

(viii) Aerosols

Aerosols are chemicals released in the air in vapour form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aeroplanes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.

(ix) Radioactive Substances

These are released by nuclear explosions and explosives. These are extremely harmful for health.

(x) Fluorides

Rocks, soils and minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

POLLUTION IN INDIA

India supports a large network of factories and industries. These factories are generally localized in eight or ten large industrial centres. These are also a great source of air as well water pollution. To be on a safer side delocalisation of industries is the need of the time.
This would lead to an even distribution of pollutants and faster degeneration of pollutants.

The major pollutants coming out from these industries are -
(i) Industrial Pollutants. The common air pollutants from industries are SO_2, CO, CO_2, H_2S and hydrocarbons together with dust, smoke and grit. These are produced by the burning of coal and petroleum and by the combustion of lignite at thermal power stations. The chemical industries release HCl, chlorine, nitrogen oxide and oxides of copper, zinc, lead and arsenic.
The fertilizer factories at Gorakhpur and Ahmedabad; the steel industries at Bhilai, Rourkela, Jamshedpur and Durgapur pollute the air with above-said gases.

(ii) Automobile Exhausts. Automobiles run by petrol and diesel produce CO, nitrogen oxides and hydrocarbons. Hundreds and thousands of tonnes of hydrocarbons and CO are emitted into air daily. Metropolitan cities harbour lakhs and crores of automobiles. Every gallon of petrol consumed by automobiles produces 3 pounds of carbon monoxide and 15 pounds of nitrogen oxide.

(iii) Ionizing Radiations from Radioactive Substances. Ionizing radiations include alpha, beta particles and the gamma rays etc. These are produced by atomic explosions and testing of atomic weapons.

Effects of Air Pollution

Effect on Plants
(*i*) SO_2 causes chlorosis and also results in the death of cells and tissues.
(*ii*) Fluorides and PAN damage leafy vegetables such as lettuce and spinach.
(*iii*) Oxides of nitrogen and fluorides reduce crop yield.
(*iv*) Smog bleaches and blaze foliage of important leafy plants.
(*v*) Hydrocarbons cause premature yellowing, fall of leave and flower buds, discoloration and curling of sepals and petals.
(*vi*) Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.
(*vii*) Ozone damages cereals, fruits, and cotton crop.

Effect on Man
The effect of pollutants on animals and man are as follows-
(i) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and oedema.
(*ii*) Ozone has been reported to produce chromosomal aberrations.
(*iii*) SO_2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract.
(*iv*) SO_2, CO and NO_2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.
(*v*) Cotton dust leads to respiratory disorders *e.g.* bronchitis and asthma.

(*vi*) Smoking of tobacco causes cancerous growth in lungs.

Change in Climate

CO_2 content of air is increasing due to deforestation and combustion of fuel. This increase is affecting the composition and balance of gases in the atmosphere. Increase in CO_2 concentration may increase the atmospheric temperature, enhancing the greenhouse effect. A rise of global temperature by more than 2-3 degrees may melt glaciers and polar ice. This would lead to a rise in ocean level and consequent flooding and submergence of coastal areas. Rainfall pattern may also change, affecting agricultural output in various regions of the world. Methane (CH_4) and Nitrous oxide (N_2O) are the other important greenhouse gases. Flooded wetlands and cattle ranches are the main sources of CH_4. N_2O enters the atmosphere mostly from agricultural chemicals. Chlorofluorocarbons (CFCs) emitted from fridges and air-conditioners deplete the ozone layer in the stratosphere. Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth. This may cause, sunburn, blindness and inactivation of proteins, RNA, DNA and plant pigments.

Aesthetic Loss

Dust and smoke spoil the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists. Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air Pollution

Following measures have been suggested to control air pollution-
(*i*) Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it
(*ii*) Particles larger than 50 mm are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.
(*iii*) The height of chimneys should be increased to the highest possible level to reduce pollution at the ground level.
(*iv*) SO_2 pollution can be controlled by extracting sulphur from the fuel before use.
(*v*) Pollution control laws should be enforced strictly.
(*vi*) Trees should be planted on the roadside, riverbanks, parks and open places as they keep the environment fresh.
(*vii*) Population growth, which is the main cause of pollution should be checked.
(*viii*) Nuclear explosions should be restricted.

II. Water Pollution

Water is extremely essential for life, this common fact is known to all. It is required to meet our basic needs in day to day life viz., cooking, drinking, bathing, disposal of sewage, irrigation, generating electricity in power plants, cooling and manufacturing different products in industries and the disposal of industrial wastes. During all these processes the undesirable substances are added to the water resources to a great extent. This alters the basic chemistry of water in rivers and streams.

Dr. Subin K Jose Christ College

Sources of Water Pollution

(i) Domestic sewage
This includes household wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water-based paints.

(ii) Industrial effluents
The industrial wastes are discharged in the adjoining rivers and streams through flush lines of factories. The textiles, sugar and fertilizers factories, oil refineries, drugs manufacture, rubber, and rayon fibres, the paper industries and the chemical factories all produce Chemical pollution.

(iii) Agricultural source
Increased use of fertilizers has become essential for high yielding crop plants. Excess of nitrates used as fertilizers seep into ground water is carried into lakes and pond. On entering the drinking water supply system these create several health problems.

(iv) Pesticides
These include insecticides, fungicides, nematicides, rodenticides, herbicides and soil fumigants. These contain chlorinated hydrocarbons, organophosphates, metallic salts, carbonates, acetic acid derivatives etc. many pesticides are non-degradable. They pass through the food chains and accumulate in fatty tissues thus causing several health hazards.

(v) Thermal pollution
Power plants and nuclear power stations are the main sources of thermal pollution of water where water is used for cooling and becomes hot. The hot water on entering the main water body raises its temperature, which kills fishes and other aquatic animals and increases the rate of respiration in aquatic plants.

(vi) Pathogenic organisms
Sewage and domestic waste from houses introduce pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.

(vii) Mineral oils
Oil from oil spills and washings of automobiles finds way into river water through sewers.

(viii) Underground water pollution
Underground water particularly in cities and industrial areas is no more pure and safe. The sources of underground water pollution are sewage, seepage, pits, industrial effluents, septic tanks, fertilizers and pesticides, garbage etc.

(ix) Marine water pollution
River and stream network sources of water ultimately end up ocean and seas. Thus, these acts as the sink of all natural and man-made water-based pollutants. The main sources of oceanic pollution are discharges of oil, greases, petroleum products, detergents, sewage and garbage including radioactive wastes.

Effect of Water Pollutants

The main effects of water pollutants are:
1. Compounds of mercury, arsenic and lead are poisonous and chemically harmful as they even affect water treatment plants e.g. organic sulphur compounds interfere with nitrification.

2. Mercury when dissolved in water is absorbed by aquatic plants and enters the food chain. Lead impairs metabolism and brings about congenital deformities, anaemia etc.

3. Cadmium damages kidneys and liver.

4. Inorganic nitrates and phosphates promote growth of oxygen-consuming algae, which result in the death of fishes and other aquatic animals.

5. Presence of dyes and compounds in the discharged water changes the colour of water.

6. Soap, detergents and, alkalis result in foam formation.

7. Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odours of water.

8. The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life (Eutrophication).

9. Biomagnification is the increase of toxic materials at each trophic level of a food chain.
For example, DDT after reaching a water system is absorbed by the microorganisms on which smaller fishes feed. From them, DDT reaches the carnivorous animals. Since bigger fishes consume more food, large amounts of DDT accumulate in their body.

CONTROL OF WATER POLLUTION

(*i*) Separate ponds and tanks to be used for cattle and animals.
(*ii*) Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.
(*iii*) In towns where sewage facilities are not available, septic tanks should be made in the houses.
(*iv*) Rivers and lakes should not be used for bathing or washing as it contaminates water.
(*v*) Domestic sewage and industrial wastes should be treated before discharging them into drains.

Treatment of waste Water

Domestic sewage and industrial wastes should be properly treated before these are drained in the mainstream water. Treatment involves the following two steps:

(i) Sewage treatment
It involves following steps:
Primary treatment. It involves physical processing of sedimentation, flotation and filtration where sewage water is passed through screens to remove larger particles and then through grinding mechanism to reduce the larger particles to smaller size. The sewage is finally passed through settling tanks to remove suspended impurities.
Secondary treatment. Sewage obtained after primary treatment is sent to aeration tank where it is mixed with air and sludge laden with bacteria and algae. The algae provide oxygen to the bacteria and decompose organic matter into simple compounds. Chlorination is finally done to remove bacteria.
Tertiary treatment. In the third and last step water is passed through ion exchangers to remove dissolved salts.

(ii) Treatment of industrial effluents
Treatment of industrial effluents involves neutralization of acids and bases, removal of toxic compounds, coagulation of colloidal impurities, precipitation of metallic compounds and reducing the temperature of effluents to decrease thermal pollution.

Dr. Subin K Jose Christ College

Marine Pollution

nts of sewage, garbage, and agricultural discharge, biocides, including heavy metals. Besides this discharge of oils and petroleum products and dumping of radionuclides waste into sea also cause marine pollution. Huge quantity of plastic is being added to sea and oceans. Over 50 million lb plastic packing material is being dumped in sea of commercial fleets. Many marine birds ingest plastic that causes gastro-intestinal disorders. The chemical principle in PCBs causes more damage as thinning of eggshell and tissue damage of egg. Radionuclide waste in sea includes Sr-90, Cs-137, Pu-239, and And Pu-240.

The pollutants in sea may become dispersed by turbulence and ocean currents and finally becomes a part of food chain. Bioaccumulation in food chain may result into loss of species diversity. The pollution in Baltic sea along the coast of Finland, took place largely from sewage and effluents from wood industries. This pollution effect brought changes. in species diversity in the bottom fauna. In less polluted water there was rich species diversity, which tended to decrease with increasing pollution load. In heavily polluted areas, macroscopic benthic animals were absent, but chirognomy larvae occurred at the bottom. In marine water the most serious pollutant is oil. Spill of oil or petroleum products due to accidents/ deliberate discharge of oil polluted waste brings about pollution. About 285 million gallons of oil are spilled each year into ocean, mostly from transport tankers. Oil pollution causes damage to marine fauna and flora including algae, fish, birds, and invertebrates. About 50,000 to 2,50,000 birds are killed every year by oil. The oil is soaked in feathers, displacing the air and thus interferes with buoyancy and maintenance of body temperature. Hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer. Detergents used to clean up the spill are also harmful to marine life.

Thermal Pollution

The increase in water temperature by industrial units such as steel and iron factories, electric powerhouses and atomic power plants may be called as thermal pollution. Some of the industries generate their own power supply where water is used to cool the generators. This hot water is released into the main stream, causing a warming trend of surface waters. If the drainage is poorly flushed, a permanent increase in the temperature may result. Many organisms are killed instantly by the hot water resulting into a high mortality. It may bring other disturbance in the ecosystem. The eggs of fish may hatch early or fail to hatch at all. It may change the diurnal and seasonal behaviour and metabolic responses of organisms" It may lead to unplanned migration of aquatic animals. Macrophysics population may also be changed. As temperature is an important limiting factor, serious changes may be brought about even by a slight increase in temperature in a population. Heat stress induces expression of specific gene families called heat shock genes, which lead to the synthesis of a new set of proteins called heat shock proteins. Heat shock proteins have been found in every organism from unicellular prokaryotes to multicultural organisms including Homo sapiens. Heat Shock Proteins synthesis lead to acquired thermo tolerance, i.e. the ability of an organism to withstand a normally lethal temperature. Thermo tolerant genotypes show adaptations at various levels of organization besides showing qualitative and quantitative differences in heat shock proteins as compared to the thermo sensitive genotypes.

III. SOIL POLLUTION

Soil Pollution

Like water and air, soil is also equally important for living organisms. It supports plants on which. all other living organisms depend. The process of soil formation is so slow that the soil may be regarded as a non-renewable source. Therefore, the study and control of soil pollution is important. Any substance that reduces soil productivity is called soil pollutant.

Sources of Soil Pollution

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its productivity. These are

1. Chemicals present in industrial waste.
2. Pesticides and insecticides that are sprayed on crops.
3. Fertilizers and manures that are added to the soil to increase the crop yield.

Effect of Soil Pollutants

Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms. Pesticides are absorbed by the plants and then transferred to other organisms. Hence, they affect food chains and food webs. Excretory products of livestock and human beings used as manure pollute the soil besides giving high yield. The faulty sanitation and unhygienic practices of the people add to the soil pollution. Pathogens present in the wastes

and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.

Types of Soil Pollution

It is of the following types-

(i) Positive soil pollution

Reduction in the productivity of soil due to the addition of undesirable substances like pesticides, herbicides, fertilisers, etc. is called positive pollution. These pollutants have cumulative effect and kill the soil organisms.

(ii) Negative soil pollution

It is caused by the removal of useful components from soil by erosion, deforestation and improper methods of agriculture.

Salination of Soil

Increase in the concentration of soluble salts is called salination. This adversely affects the quality and productivity of soil. It takes place in two ways: accumulation of salts dissolved in irrigation water on the soil surface due to intensive farming and poor drainage, and deposition of salts as white crust during summer months drawn by capillary action from the lower surface to the top surface.

Control of Soil Pollution

Various measures to control soil pollution are-

1. Transfer stations for bulk shifting of refuse should be constructed in cities and big towns.
2. Pneumatic pipes should be laid for collecting and disposing wastes.
3. Materials like paper, glass and plastics can be recycled.
4. Metals should be recovered from scrap and disposed materials.
5. Use of chemical fertilizers should be reduced by the use of bio fertilizers and manures.
6. Use of pesticides can be reduced by adopting biological control of pests.
7. Use of cattle dung and agricultural wastes in biogas plants should be encouraged.
8. Deforestation can check soil erosion to a great extent.

Land Degradation

Besides pollution, land and soil face several other problems. Removal of topsoil is called soil erosion. Soil erosion factors are water, wind, ocean, waves and glaciers, felling of trees, overgrazing by cattle, over-cropping etc. Erosion occurs both in wet and dry regions. It leads to floods.

Soil Erosion in India

Soil erosion is a worldwide phenomenon, but it is especially high in Central Africa,

China, India, Nepal, Australia, Spain, USA and USSR. India loses about 40,000 hectares of land every year as an effect of wind and water erosion. Damage to the topsoil is 18.5% of the total world's loss. This is due to overgrazing by livestock. The population of livestock in India is the highest in the world. Overgrazing damages the topsoil, which reduces soil fertility.

(i) Deforestation of overgrazing
Over-grazing is the main cause of soil erosion in India. Roots of grasses act as binding material and keep the soil intact, which upon grazing are destroyed.

(ii) Desertification
Loss of soil productivity by erosion of top soil results in the formation of deserts. Deserts are spreading in all continents. Desertification takes place by shifting of sand dunes by wind and overgrazing. That desert in India is spreading at the rate of 12,000 hectares of land every year.

(iii) Shifting cultivation
Tribal communities follow the practice of cutting down trees and setting them on fire and then raising the crops on the resulting ash. This is called *Jhuming* in northeastern India. It is harmful if the Jhuming cycles are longer than ten years but short cycles destroy forests and cause soil erosion. e.g. Asia and Africa.

(iv) Developmental activities
Large areas of fertile and productive croplands, woodlands and grasslands are lost to various developmental activities such as rapid urbanization, building of airports, industries, railways, roads, mining and construction of dams.

Control of Land Degradation

Following ways can control Land degradation
1. Restoration of forests and grass cover can help in prevention of soil erosion and floods.
2. By replacing shifting cultivation with crop rotation, mixed cropping or plantation cropping. Providing adequate drainage to irrigated and flood-prone lands can prevent salinity.
3. Desertification can be controlled by spread of appropriate plant species and by raising trees as wind breaks.

IV. Noise Pollution

Noise can be defined as unwanted/unpleasant sound. So, noise pollution is unwanted sound dumped into the atmosphere without regard to the adverse effects it may have. In our country urbanization and industrialization have become twin problems. Cities and towns have sprouted up where industries are concentrated. Lack of town' planning had led to

residential, commercial and industrial areas being mixed up. Houses, schools and hospitals are situated near industries. All the boons of industrialization and civilization such as motors, horns, heavy and light machinery, work and movement, blaring radios, supersonic aeroplanes have become disturbing and irritant. Our ears can hear ordinary conversation between 30-60 decibels. Modern conversation has a noise value of 60 decibels. A decibel value greater than 80 decibels causes noise pollution. Noise becomes troublesome above 140 decibels.

Effect of Noise Pollution

1. Constant noise affects a man physically and mentally. Physical effects include blood vessels to contract, skin to become pale, muscles to constrict and rise in blood pressure leading to tension and nervousness.
2. High intensity sound emitted by industrial plants, bottling machines, supersonic aircrafts, when continued for long periods of time not only disturbs but also permanently damages hearing.
3. Offices, industries and crowded places where constant noise prevails can produce temper tantrums, headaches, fatigue and nausea.
4. Loud and sudden noise affect the brain. Intermittent noise leads higher incidence of psychiatric illness and also a danger to health of pregnant mothers and small infants.
5. Noise has harmful effects on non-living materials too, *e.g.* cracks develop under the stress of explosive sound.

Control of Noise Pollution

Following methods can control noise pollution:
1. Limited use of loudspeakers and amplifiers.
2. Excursing control over noise producing vehicles.
3. Industrial workers should be provided with ear plugs.
4. Delocalisation of noisy industries far away from dwelling units.
5. Within a radius of 10 miles of airport, no buildings or factories should be allowed.
6. Plants and trees should be planted all around the hospitals, libraries and schools and colleges.
7. Personal protection against noise can be taken by using, cotton plugs in the ear.

Nuclear hazard- Radiation

The radiations from the atomic blasts cause several health hazards. The radiations carry high energy and remove electrons from atoms and attach them to other atoms producing positive and negative ion pairs. Hence, they are known as ionizing radiations. The ionization property of these radiations proves to be highly injurious to the protoplasm. The ionizing radiations of ecological concern are classified as follows:

Corpuscular Radiations

These consist of streams of atomic or subatomic particles, which transfer their energy

to the matter they strike.
(i) Alpha particles
These particles are large and travel few centimetres in the air. These cause large amount of local ionization.
(ii) Beta particles
These are small particles characterized by having high velocities. They can travel a few meters in space. These are capable of entering into the tissues for few centimetres.
Since alpha and beta particles have low penetration power, they can produce harmful effects only when absorbed, ingested or deposited in or near living tissues.
(iii) Electromagnetic radiations
Electromagnetic radiations include waves of shorter wavelengths. These are capable of traveling long distances and can readily penetrate the living tissue. These include gamma rays. These can penetrate and produce effect even without being taken inside.

Other Types of Radiations

Besides radioactive radiations, some other radiations are also present in the atmosphere.
(i) Neutrons
These are large uncharged particles, which do not cause radiation by themselves, but they produce radioactivity in non-radioactive materials through which they pass.
(ii) X-rays
These are electromagnetic waves very similar to gamma rays, but originate from the outer electron shell of radioactive substances, which are not dispersed in nature.
(iii) Cosmic rays
These are radiations from the outer space, which contain alpha and beta particles together with gamma rays.

Sources of Radiations

The radiations are produced from the radioactive elements, which are known as radionuclides or radioactive isotopes, e.g. Uranium. Radium, Thorium, and Carbon-14. These contribute to background radiation. But isotopes of certain metabolically important elements like Carbon-14, Cobalt-60, Calcium 45, Iodine-131, Phosphorus-32, etc. are not ecologically harmful but are used as tracers. The third category of radionuclides comprises of fission products of uranium and certain other elements. These are cesium, strontium, and plutonium etc.

Biological Effects of Radiation

The effects of radiation have revealed that acute doses are found to be deleterious and may kill the organisms, whereas the increase in radiation in biological environment leads to different kinds of mutations. The effects of Cobalt-60 or Cesium-137 gamma radiations have now been studied on communities and on ecosystems at different places. The research concludes that Irradiations eliminate varieties in species. The sensitivity of cells, tissues and organisms to radiation varies. The cells with larger chromosomes are more sensitive. Herbaceous communities and early stages of succession are resistant than the mature forest.

Dr. Subin K Jose Christ College

Nuclear Fall Outs or Radioactive Fall Outs

The atomic blasts not only produce the local ionizing radiations at that time but the radioisotopes produced as a result of explosion enter the atmosphere and continue to fallout gradually over broad geographic areas for a very long time. These are known as nuclear fallout or radioactive fallout. These are dangerous for life as they also produce ionizing radiations.

Biological Effects of Fall outs

The fallout of radionuclides combines with various metals and dust and from colloidal suspension combines with organic compounds to form complexes. The smaller particles of radionuclides adhere tightly to the leaves of plants and produce radiation damage to leaf tissue besides entering the tissues also. Through grazing animals these enter the food chain directly at the primary consumers level. Radionuclides, which combine with organic substances, enter the food chain through producer tropic level. Therefore, the radionuclides fall out manages to enter the body of all living organisms. Radioactive Strontium-90 poses a health hazard in human beings and other higher vertebrates. It continues to deposit in the bones and causes bone cancer and leukaemia. Radioactive Cesium-137 is known to cause irreversible genetic changes in different organisms. The fallout radiations do cause changes in the genetic constitution of organisms, resulting in gene mutations and chromosomal aberrations. Their considerable, doses may kill, cripple and alter the animals and plants in the areas.

Control of Radiation Pollution

Following measures can help in controlling the radioactive pollution:
(*i*) Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.
(*ii*) Leakage of radioactive elements from nuclear reactors, laboratories, transport, careless handling and use of radioactive fuels should be checked.
(*iii*) Level of radiation pollution should be monitored regularly in risk areas.
(*iv*) Disposal of radioactive wastes deserves special attention.

Case studies

Hiroshima and Nagasaki Episode

The tale of Hiroshima and Nagasaki is a painful experience. It is for the first time that an atomic bomb has been exploded over human population. The incident took place on August 6,1945 at 8:15 a.m. The bomb with an approximate temperature of around 100 million 0°C was exploded on a fine morning in Hiroshima (Japan). The temperature of the city hiked like anything, almost like an oven. After three days, Nagasaki too suffered the ravages of a nuclear attack. More than 1,00,000 people were reported to die just after the event took place. Since radiations from nuclear elements remain active even after, the generations to follow up also suffered from various diseases. Even the babies in the mother's womb were affected and a few perished. Blindness, deafness, skin diseases and cancers, distortion of bones and other parts became the fortune of human civilization.

Dr. Subin K Jose Christ College

Chernobyl Accident

This incident took place in Ukraine on April 26, 1986. There was a Chernobyl nuclear power plant in Ukraine after which the event has been named. Approximately four million people had been reported to suffer from the accident. The accident contaminated neighbouring environment up to several kilometres. The sites were evacuated and resettlement was done for the affected people. The radiations released affected ground water and surface waters, affecting large areas of Europe. 131 Iodine and 137 Cesium are the most dangerous amongst the 20-odd radioactive elements released during Chernobyl disaster. As per the Soviet Health Ministry, 31-persons died shortly after the disaster. Of the 276,614 people who worked for rehabilitation and cleaning operations, a total of 1065 died by the end of 1990.

Solid Waste Management

Environmental problems also include solid waste disposal. At all levels of development human beings produce domestic wastes. These comprises of kitchen wastes, ashes from fires, broken utensils and worn-out clothing. The industrial revolution leads to the concentration of people in urban areas with very high population density. This resulted in addition of new sources of wastes from shops, institutions and factories. In developed countries services for the regular removal of domestic and trade wastes have been in operation for last many years.
Many changes have taken place in our society. The character of the wastes has altered with rising living standards, changes in retail distribution methods and fuel technology.
Grave environmental concerns have come up with rise in construction of new buildings, supermarkets, and industrial wastes of many kinds. In the industrialized countries, therefore, basic health and environmental problems have been solved in the storage and collection of solid wastes, although major problems remain in regard to resource recovery and disposal. The technology of wastes handling is now highly developed. The substantial sectors of industry are engaged in the production of equipment with regard to removal of wastes. Many institutions give technical training and support. However, developing nations like India are facing the problems of urbanization with high population densities. The developing countries are aware of the importance of avoiding the environmental pollution. The quality of urban environment is a matter of growing concern and the importance of solid wastes management is increasingly being recognized.

Sources and Characteristics

Solid wastes generally refer to describe non-liquid waste materials arising from domestic, trade, commercial, industrial, agriculture and mining activities and from the public services. Disposal of sludge's (liquid waste) of some kind fall within the scope of solid waste management. These arise primarily from industrial sources and from sewage treatment plants. Solid wastes comprise countless different materials; dust, food wastes, packaging in the form of paper, metals, plastics or glass, discarded clothing and furnishing, garden wastes and hazardous and radioactive wastes. The method and capacity of storage, the correct type of collection vehicle, the optimum size of crew and the frequency of collection depend mainly on volume and density. Just as solid wastes comprise a vast number of materials, they arise from a multitude of separate sources as well as many kilometres of streets upon which solid wastes accumulate. Thus, the four main aspects

of solid wastes management are: (*i*) storage at or near the point of generation, (*ii*) collection, (*iii*) street cleansing, (*iv*) disposal. The main constituents of solid wastes are similar throughout the world, but the proportions vary widely. As personal income rises, paper increases, kitchen wastes decline, metals and glass increase, total weight generated rises and the density of the waste declines. Clearly, the amount of work involved in refuse collection depends upon the weight and volume of wastes generated and the number of collection points from which the wastes have to be removed.

Health and environmental implications

Improper handling of solid wastes results in increased potential risks to health and to the environment both. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from skin contact with wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. More serious, however, and often unrecognized, is the transfer of pollution to water, which occurs when the leach ate from a refuse dump enters surface water or wastes, either in the open air, or in plants that lack effective treatment facilities for the gaseous effluents. Traffic accidents can result from wastes accumulated and dispersed on to streets and roads. They have caused death and injury to people in the surrounding areas.

There also persists the specific danger of the concentration of heavy metals in the food chain. These metals can be taken up by the plants growing on land on which sludge has been deposited, creating risks to the animals which graze and the humans who consume these animals.

Economic implications

Labour and transport absorb the major part of the operating cost of solid wastes management services. The level of mechanization that should be adopted for solid wastes management systems relate directly to the cost of labour, as compared to that of plant and energy. There is not much variation, worldwide, in energy or mechanical plant costs, but there is wide variation in the range of labour costs. Thus, there are no universally applicable solid wastes management systems. Every country must evolve indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates, equipment, manufacturing capacity, energy costs etc. It is necessary to deploy a complete set of technical skills, which derive from several professional disciplines. These include civil and mechanical engineering, chemical engineering, transport organization, land use planning and economics.

Refuse Collection

A refuse collection service requires vehicles and labour. For their efficient development, three components are basic:

(1) Travel to and from the work area,

(2) The collection process, and

(3) The delivery process.

The use of large, widely spaced communal storage sites is usually a failure because the demand placed on the householder goes beyond his willingness to cooperate. Communal

storage points should, therefore, be at frequent intervals, Madras and Bangalore provide fixed concrete containers. They are fairly successful because they place reasonable and acceptable duty on the residents, thus very little domestic waste is thrown in the street. In another system of block collection, a collection vehicle travels a regular route at prescribed intervals, usually every two days or every three days, and it stops at every street intersection, where a bell is rung. At this signal the residents of all the streets leading from that intersection bring their wastes containers to the vehicle and hand them to the crew to be emptied. A crew of one or two men is adequate in number, as they do not need to leave the vehicle.

Sanitary Landfill Disposal

Land disposal (burying of wastes) is the only approved method of disposal, which is performed at a single site. Incineration, composting, and salvage are either a form of refuse handling or processing. They are not complete methods of disposal, and they require disposal of residue. Sanitary landfill can be defined as the use of solid wastes for land-reclamation, a typical example being the restoration, by filling to the original level of man-made surface dereliction such as a disused surface, mineral excavation. Solid wastes may also be used to improve natural features by raising the level of low-lying land to enable it to be used or cultivation or industrial development. Thus, sanitary land filling has two essential features, which differentiate it from crude dumping:

(*i*) Only sites that will be improved not degraded, by a change of level are selected.

(*ii*) Simple engineering techniques are used to control the manner in which the wastes are deposited, so that dangers to public health and the environment are avoided.

Unfortunately, most of the world's wastes are disposed off by uncontrolled dumping which blights the land for any future use and causes serious risks of water pollution and vector breeding. Very few cities operate sanitary land filling to standards, which totally control health and environmental dangers; most of those that do are in the industrialized countries.

Control of Hazards

(*i*) Control over pathogens is dependent upon a rigorous policy of covering the wastes soon after deposit. This serves both to isolate the wastes and to retain the heat, which is quickly generated during aerobic decomposition.

(*ii*) The main source of insects will be the eggs of flies. Which have been deposited in the wastes before they arrive at the site. Most of these will be buried deep in the wastes and will succumb to the temperature increase.

(*iii*) Fire at a sanitary landfill can arise from innumerable causes, hot ashes in a vehicle delivering wastes: a cigarette thrown by a worker; the sun's ray though a fragment of glass on the surface. With some kinds of wastes the consequence of fire may be very serious and underground fires have been known that ultimately caused the collapse of the surface into voids caused by the fire.

(*iv*) The pollution of static water, ditches, river or the sea occurs when a sanitary landfill adjoins a body of water. The normal source of the leach ate causing this

pollution is rain falling on the surface.

Incineration

Open burning, barrel burning, and other related uncontrolled forms of burning have a long history of use. Many liquid wastes and pathological wastes are best disposed of by incineration. Originally, solid waste incineration was practiced to reduce the quantity of refuse or disposal. After it was proven that heat could destroy most pathogens, incinerators were used in hospitals for destruction of pathological wastes. With few exceptions, incinerators are not "good neighbours," and the environmental nuisances of dust. Noise and air pollution have provoked communities to an anti-incinerator philosophy. To overcome this negative community feeling is going to require that incineration prove its worth and that imagination be used in the design of future units. Incineration of solid wastes yields the highest percent of volume reduction except for Pyrolysis. Unlike a sanitary landfill, incineration of solid wastes can be performed on the premises of apartments, supermarkets, departments' stores, and similar establishments.

Composting

Composting involves the biological stabilization of solid matter either under aerobic or anaerobic conditions. The end product of composing is an organic material, which could have beneficial value as a soil conditioner or plant mulch. In addition to producing a modified solid waste material, which can be useful in land reclamation, composting does yield a volume reduction of solid waste by about 40-60% of the compostable fraction.

Pyrolysis

Pyrolysis is a thermal process where oxidation of the organic fraction is not allowed to occur. Instead, the organic matter is evolved from the refuse with heat, leaving an ash consisting mostly of carbon and any inorganic matter, e.g. metal and glass are not removed before Pyrolysis. Some of the gases, which have been volatized, are condensed while the remainder is burned to supply the heat (energy) needed to pyrolyze the material. Since oxidation is prevented, the Pyrolysis process must be performed in an atmosphere of argon, helium or nitrogen.

Role of an Individual in Prevention of Pollution

Which are the most viable, efficient and economical ways to eliminate pollution problems? We very often see people blaming public and government sectors to control pollution through controlling market mechanisms and government blaming people to avoid and check pollution.

Who would control whom? Many ecologists and environmental scientists believe in that pollution problems can be overcome by using market mechanisms to reduce pollution rather than rigid rules and regulations. However, on the other hand man should identify and gear up his own potential to curb down pollution. Man could achieve this by identifying his own role at individual level in prevention of pollution. This is possible through environmental awareness, education and enlightenment.

Dr. Subin K Jose Christ College

Ways and means by which pollution problems can be greatly reduced at individual level are:

1. Masses at personal level should determine to consume optimum level of resources, which would lead a comfortable life. Because excessive resource consumption is in someway related to pollution problems and hazards (natural and anthropogenic both).

2. Waste disposal at personal level should be optimally reduced as waste destruction by any means causes pollution.

3. Maintenance of vehicles should remain proper as to avoid introduction of harmful gases and other pollutants in to the atmosphere.

4. Generators and other household gadgets that add to pollution of environment should be kept well maintained.

5. Use of chemical fertilizers should be limited as to avoid water pollution e.g. DDT

6. Timely disposal of waste to prevent decomposition of household refuge as to check foul odours and spread of disease by insects, flies and other pathogenic bacteria.

7. Industrialists should check for proper disposal of treated water from factory units as to avoid thermal pollution of water bodies. They should also deploy a water treatment plant to prevent the flow of hazardous material.

8. Service centres of vehicles should minimize the disposal of organic solvents into the main drains.

9. Music lovers should listen and operate their music systems at optimum levels as to avoid noise pollution.